for Information Technology -

Geographic Information Framework - Data Content Standards For Geodetic Control

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Foreword

The primary purpose of the standard is to support the exchange of geospatial data related to geodetic control. It provides a common baseline for the content of geodetic control databases for public agencies and private enterprises. This standard was developed with a certain philosophy which includes the following concepts:

- Keep it simple; have the fewest number of data elements possible, but make those data elements mandatory. This encourages use of the standard.

- Anticipate which data elements other surveying and mapping organizations, at all levels of government, have readily available. Again, this was encourages use of the standard.

- Use single data types, e.g., coordinate types. Different organizations store their data or make it available using a variety of data types, e.g., latitude-longitude, State Plane Coordinates, UTM Coordinates, elevations in meters, elevations in feet, etc. Because the data provider, the organization creating the data, is the one most knowledgeable about their data, they are the ones who should be responsible for converting their data into this single data type. Again, multiple data types will make the standard less useful to data users.

Note: The rationale for this concept is based on having tools available, validated through the Federal Geographic Data Committee / Federal Geodetic Control Subcommittee, for converting other types of horizontal coordinate values to latitude-longitude.

- While geospatial data users often associate geodetic control coordinates with the highest accuracy coordinates attainable, there is no threshold set in this standard for the accuracy of geodetic control coordinates, but the accuracy of the coordinates is a required data element that must be stated.

- Make the standard compatible with current GIS software so data users do not have to convert the data to import it into their systems.

- Require metadata supporting how the coordinates were derived and how their corresponding accuracy values are estimated.

This standard has been developed to fulfill one of the objectives of the NSDI, i.e., to create common geographic base data for seven critical data themes. These core themes are considered framework data, reflecting their critical importance as geographic infrastructure.

As stated in *FRAMEWORK - Introduction and Guide*, [19]:

> **"Geodetic Control**
>
> Geodetic control provides a common reference system for establishing the coordinate positions of all geographic data. It provides the means for tying all geographic features to common, nationally used horizontal and vertical coordinate systems. The main features of geodetic control information are geodetic control stations. These monumented points (or in some cases active Global Positioning System control stations) have precisely measured horizontal [and/]or vertical locations and are used as a basis for determining the positions of other points. The geodetic control component of the framework consists of geodetic control stations and related information – the name, feature identification code, latitude and longitude, orthometric and ellipsoid heights, and metadata for each station. The metadata for each geodetic control point contains descriptive data, positional accuracy, [physical] condition, and other pertinent characteristics for that point.
>
> Geodetic control information plays a crucial role in developing all framework data and users' applications data, because it provides the spatial reference source to register all other spatial data. In addition, geodetic control information may be used to plan surveys, assess data quality, plan data collection and conversion, and fit new areas of data into existing coverages."

The Federal Geodetic Control Subcommittee (FGCS), a Subcommittee on geodetic data of the Federal Geographic Data Committee, has been established to promote standards of accuracy and currentness in geodetic data financed in whole or part by Federal funds; to exchange information on technological improvements for acquiring geodetic data; to encourage the Federal and non-Federal community to identify and adopt standards and specifications for geodetic data; and to collect and process the requirements of Federal and non-Federal organizations for geodetic data. The lead agency responsible for the coordination, management, and dissemination of geodetic data is the Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, National Geodetic Survey.

The Geospatial One-Stop initiative is an e-government initiative of the federal government designed to expedite the creation of the seven framework layers. This standard has been developed in response to the One-Stop initiative to realize the goals and objectives of the NSDI. Suggestions for improvements to this standard are welcome.

Note to Commenters: Although this working draft is presented as a stand-alone standard, it is intended to become part of a single, harmonized NSDI Framework Data Content Standard. In all, five transportation sub-themes and seven Framework themes will be harmonized into one standard for presentation to the InterNational Committee on Information Technology Standards, Geographic Information Systems. Structural and formatting changes are likely to occur to this and other working drafts during the harmonization process. The single, harmonized draft will also be made available for public review and comment.

See Figure 8.1 - Nested Relationship of NSDI Framework Data Content Standard Harmonization

To comment on working drafts, please use the Microsoft Excel comment spreadsheet located at:

http://www.geo-one-stop.gov/Standards/index.html

Only comments received in this format will be considered. You can email comments to: GeospatialComments@geo-one-stop.gov., or mail them to the following address:

Geospatial Comments
The MNG Center at SRA International
2425 Wilson Blvd., Suite 400
Arlington, VA 22201

1.0 Scope, Purpose and Application

1.1 Scope

Geodetic control surveys are usually performed to establish a basic control network (framework) from which supplemental surveying and mapping work is performed. Geodetic network surveys are distinguished by use of redundant, interconnected, permanently monumented control points that comprise the framework for the National Spatial Reference System (NSRS) or are often incorporated into NSRS.

These surveys must be performed to far more rigorous accuracy and quality assurance standards than those for control surveys for general engineering, construction, or topographic mapping purposes. Geodetic network surveys included in NSRS must be performed to meet automated data recording, submittal, project review, and least squares adjustment requirements established by the FGCS.

1.2 Purpose

This document provides a common methodology for creating data sets of horizontal coordinate values and vertical coordinate values for geodetic control points represented by survey monuments, such as brass disks and rod marks. It provides a single data structure for coordinate values obtained by one geodetic survey method (e.g., a classical line-of-sight traverse) with coordinate values obtained by another geodetic survey method (e.g., a Global Positioning System (GPS) geodetic network survey).

1.3 Application

This standard is applicable to any geodetic control data set and is intended to facilitate a common methodology to create, manage, and share geodetic control data sets from various organizations at the Federal, state, local, and tribal government levels; academia; and the private sector.

NOTE: The team developing this standard recognizes from comments from reviewers of draft versions of this standard that there exists a larger set of points having geographic coordinates, i.e., “coordinated points.” Within the population of coordinated points, there is a subset of points known as “control points.” Geodetic control points belong to this family of control points, which includes: Public Land Survey System points, local government control points, project control points for public and private projects, aerial-photo control points, etc. While there is definitely a need for a data content standard to cover all control points, the developers of this data content standard decided to limit the scope to only geodetic control points. However, it should be noted that this standard can serve as a model for other types of non-geodetic “control points” and “coordinated points.”

2.0 Normative References

2.1 Standards Documents

The following standards documents contain provisions that are relevant to certain parts of this standard.

[1] ANSI INCITS 320, *Spatial Data Transfer Standard (SDTS)*, 1998.

[2] INCITS 353, *Spatial Data Standard for Facilities, Infrastructure, and Environment*, 2001.

[3] ISO 6709, *Geographic information - Standard representation of latitude, longitude, and altitude for geographic locations*.

[4] ISO 19107, *Geographic information - Spatial schema*.

[5] ISO 19109, *Geographic information - Rules for application schema*.

[6] ISO 19110, *Geographic information - Feature cataloging methodology*, applies to transportation, hydrography, government units, and cadastral information.

[7] ISO 19111, *Geographic information - Spatial referencing by coordinates*.

[8] ISO 19115, *Geographic information - Metadata*.

[9] ISO 19123, *Geographic information - Schema for coverage geometry and functions*, applies to orthoimagery and elevation.

[10] FGDC-STD-001, *Content Standard for Digital Geospatial Metadata (version 2.0)*, 1998.

[11] FGDC-STD-002.5, *Spatial Data Transfer Standard (SDTS), Part 5: Raster Profile and Extensions*.

[12] FGDC-STD-002.6, *Spatial Data Transfer Standard (SDTS), Part 6: Point Profile*, 1998, defines the format to be used to transfer geodetic coordinate data, including the accuracy of the coordinate values, between geographic information systems.

[13] FGDC-STD-002.7, *Spatial Data Transfer Standard (SDTS), Part 7: Computer-Aided Design and Drafting (CADD) Profile*, 2000, extends the Vector Profile for CADD elements.

[14] FGDC-STD-007.1, *Geospatial Positioning Accuracy Standards, Part 1: Reporting Methodology*, 1998, provides a common methodology for reporting the accuracy of horizontal and vertical coordinate values for clearly defined features where the location is represented by a single point coordinate.

[15] FGDC-STD-007.2, *Geospatial Positioning Accuracy Standards, Part 2: Geodetic Control Networks*, 1998, provides a common methodology for determining and reporting the accuracy of horizontal and vertical coordinate values for geodetic control points represented by survey monuments, such as brass disks and rod marks.

[16] FGDC-STD-007.3, *Geospatial Positioning Accuracy Standards, Part 3: National Standard for Spatial Data Accuracy*, 1998.

2.2 Referenced and Related Publications

[17] *Input Formats and Specifications of the National Geodetic Survey Data Base*, FGCS, 1994, defines the procedures and formats for submitting geodetic data for inclusion into NSRS.

[18] *Geodetic Glossary*, National Geodetic Survey, 1986.

[19] *FRAMEWORK - Introduction and Guide*, (National Spatial Data Infrastructure, FGDC, 1977.

[20] *Federal Register Notice - Affirmation of Datum for Surveying and Mapping Activities*; June 13, 1989; NAD 83.

[21] *Federal Register Notice - Affirmation of Vertical Datum for Surveying and Mapping Activities*; June 23, 1993; NAVD 88.

3.0 Definitions

National Spatial Reference System (NSRS) is the framework for latitude, longitude, height, scale, gravity, orientation, and shoreline throughout the United States. NSRS is made up of coordinates from geodetic control points and sets of models describing geophysical processes.

Control is high-accuracy spatial data associated with a collection of well defined ground points, usually given as coordinate data.

Geodetic Control is a set of control points (also commonly referred to as "stations") whose coordinates are established by geodetic surveying methodology. They have the following characteristics:

1. They must be physical (i.e., real-world), marked points because they are used more than once, i.e., they must be recoverable.
2. The accuracy of the coordinates must be stated; and should be at the 95% confidence level. As stated previously, no threshold has been set in this standard for the accuracy of geodetic control coordinates, but the accuracy of the coordinates is a required data element.
3. The reference datum for the coordinates must be stated.
4. The coordinates must be derived through a connection to NSRS.

Horizontal Geodetic Control: [These control points are those whose horizontal coordinates (i.e., latitude-longitude) have been accurately determined, can be identified with physical points on the Earth, and can be used to provide horizontal coordinates for other surveys.] These are converted to geodetic coordinates [i.e., geodetic latitudes and longitudes] and azimuths. The former, in turn, geodetic coordinates may be converted into other kinds of coordinates such as plane coordinates in a State Plane Coordinate System. This is the form in which they are usually used in the United States for local surveys.

Vertical Geodetic Control: These control points are of two types, orthometric and ellipsoidal those whose elevations [i.e., orthometric heights] have been accurately determined, can be identified with physical points on the Earth, and can be used to provide elevations for other surveys. Elevations are referred, ideally, to the geoid. However, horizontal surfaces through selected points on mean sea level have been used for reference, as have non-horizontal surfaces defined by a combination of leveling surveys and points on [local] mean sea level.

NOTE: With the advent of 3-dimensional satellite-based surveys (e.g., Global Positioning System (GPS)), horizontal and vertical geodetic control coordinates are obtained simultaneously from the vectors derived by processing data transmitted from the satellites. Additional processing is required to convert vertical control obtained by GPS to geoid-referenced elevations (i.e., orthometric heights).

Local Accuracy of a control point is a value that represents the uncertainty in the coordinates of the control point relative to the coordinates of other directly connected, adjacent control points at the 95 % confidence level. The **reported local accuracy** is an approximate average of the individual local accuracy values between this control point and other observed control points used to establish the coordinates of the control point.

Network Accuracy of a control point is a value that represents the uncertainty in the coordinates of the control point with respect to the geodetic datum at the 95 % confidence level. For NSRS network accuracy classification, the datum is considered to be best expressed by the geodetic values at the Continuously Operating Reference Stations (CORS) supported by NGS. By this definition, the local and network accuracy values at CORS sites are considered to be infinitesimal, i.e., to approach zero.

Orthometric Height is the distance measured along the plumb line between the geoid and a point on the Earth's surface, taken positive upward from the geoid (adapted from National Geodetic Survey, 1986).

Ellipsoid Height is the distance between a point on the Earth's surface and the ellipsoidal surface, as measured along the perpendicular to the ellipsoid at the point and taken positive upward from the ellipsoid.

Datum is any quantity or set of such quantities that may serve as a referent or basis for calculation of other quantities.

Datum, Geodetic is set of constants specifying the coordinate system used for geodetic control, i.e., for calculating coordinates of points on the Earth.

NAD 83 - North American Datum of 1983 is the horizontal and 3-dimensional geodetic datum for the United States, Canada, Mexico, and Central America, based on the Geodetic Reference System 1980 ellipsoid. This datum is derived from the adjustment of more than 250,000 survey control points.

NAVD 88 - North American Vertical Datum of 1988 is the vertical geodetic datum for the United States, Canada, and Mexico. Based on a minimum-constraint adjustment of more than 750,000 vertical control points or benchmarks.

4.0 Requirements

Geodetic control is spatial data that describes individual points whose horizontal and/or vertical coordinate values have been determined using geodetic surveying methods (e.g., classical line-of-sight triangulation, traverse, and optical leveling or satellite surveys such as Doppler or GPS). For the purpose of this data content standard, each geodetic control point has four (4) basic elements. They are:

1. Designations
2. Coordinates
3. Accuracy
4. Geodetic Datum

Each of these four elements is described in detail in the following paragraphs.

NOTE: All four elements and all sub-elements within them **<u>are required</u>** to meet this standard, except where otherwise noted.

4.1 **<u>DESIGNATIONS</u>** - Two types of identifiers are used for each point in the data set: 1) a unique identifier and a descriptive identifier.

4.1.1 A **unique identifier** for each point within a data set composed of two parts: 1) a permanent identifier and 2) a namespace. The **permanent identifier** can be the organization's unique data base identifier or one generated for this data set. The **namespace** is the organization's identifier (e.g., abbreviation) for the organization who assigned/maintains the permanent identifier. The unique identifier allows traceability of each data point back to the organization and to other data held by that organization about the point. For example, the National Geodetic Survey has a multitude of information about each geodetic control point, but only the basic information following this standard will be contained in the data set generated.

NOTE: For geodetic control data sets, the uniqueness of namespace is maintained by the National Geodetic Survey through

If an organization has separate components, each providing its own data sets, the namespace should be unique within that organizational element. For example, the U.S. Army Corps of Engineers has several districts. The permanent identifier should be unique within a particular district, but each district should have their own organizational identifier. This way the combination of the permanent identifier and the namespace provides for a truly unique identifier.

For a detailed discussion of Permanent Identifiers, see Appendix 9.1.

4.1.2 A **descriptive identifier,** such as the designation/station name or mark stamping which provides the user with a more understandable name for the point, facilitates certain interactions with the point, e.g., an understanding of what to physically look for in the field. **NOTE:** Descriptive identifiers do not have to be unique within a data set.

4.2 **<u>COORDINATES</u>** - Consists of two types, Horizontal and Vertical. **BOTH** types are mandatory. However, if only an approximate value is available, then use it with its corresponding accuracy.

NOTE: Data providers should provide the best set of coordinates at the time of the request, but coordinates could change in the future based on improved, i.e., more accurate, observation techniques. Data users are encouraged to be cautious and use the latest set of coordinate values. Typically geodetic coordinates do not change by more than their stated network accuracy.

NOTE: If one set of coordinates (e.g., the horizontal coordinates) is approximate, then the other set of coordinates (e.g., the height) **<u>MUST</u>** be accurately determined following geodetic surveying techniques.

4.2.1 Horizontal Coordinates (i.e., latitude/longitude) - The curvilinear system of latitude and longitude is required. Latitudes are referenced as positive north and negative south. Longitudes are referenced as positive east and negative west. The mandatory unit for latitude and longitude is decimal degrees.

NOTE: The rationale for requiring a single type of coordinate values is based on having tools available, validated through the Federal Geographic Data Committee / Federal Geodetic Control Subcommittee, for converting other types of coordinate values to latitude-longitude.

4.2.2 Vertical Coordinates - consists of two types, Orthometric Height and Ellipsoid Height.

NOTE: Provide **BOTH** Orthometric and Ellipsoid Heights if available, **BUT** one type is mandatory.

a. **Orthometric Height** - if measured, e.g., by precise optical leveling or vertical angles. The mandatory unit for height values is meters.

b. **Ellipsoid Height** - if measured, e.g., by GPS
The mandatory unit for height values is meters.

4.3 ACCURACY - Both Local and Network accuracy values are mandatory. The mandatory unit for accuracy estimates is meters.
See FGDC-STD-007.2, *Geospatial Positioning Accuracy Standards, Part 2: Geodetic Control Networks*, [15], for the methodology for defining Local and Network accuracies.

NOTE: See Appendix 9.3 for user guidance on how to determine estimates for Local and Network accuracy values for geodetic control established using the older (e.g., first-order) methodology.

4.4 GEODETIC DATUM

Mandatory for horizontal coordinates and ellipsoid heights - Must be referenced to the North American Datum of 1983 (NAD 83) and include BOTH the datum tag (e.g., NAD 83 (1986)) and the coordinate epoch date (e.g., 1997.0). For example: NAD 83 (1986) [1997.0]. Also see *Federal Register Notice*, [20].

NAD 83 (1986) indicates horizontal coordinate values and ellipsoid height values on the NAD 83 datum resulting from the North American Adjustment completed in 1986.
NAD 83 (yyyy) indicates coordinate values on the NAD 83 datum for the North American Adjustment, but readjusted to a state or regional HARN on the date (i.e., year) shown in (yyyy). See Appendix 9.2 for an example.

Mandatory for orthometric heights - Must be referenced to the North American Vertical Datum of 1988 (NAVD 88). Also see *Federal Register Notice*, [21].

4.4.1 DATUM TAG

Represents the date of the regional least squares adjustment associated with the horizontal control point.

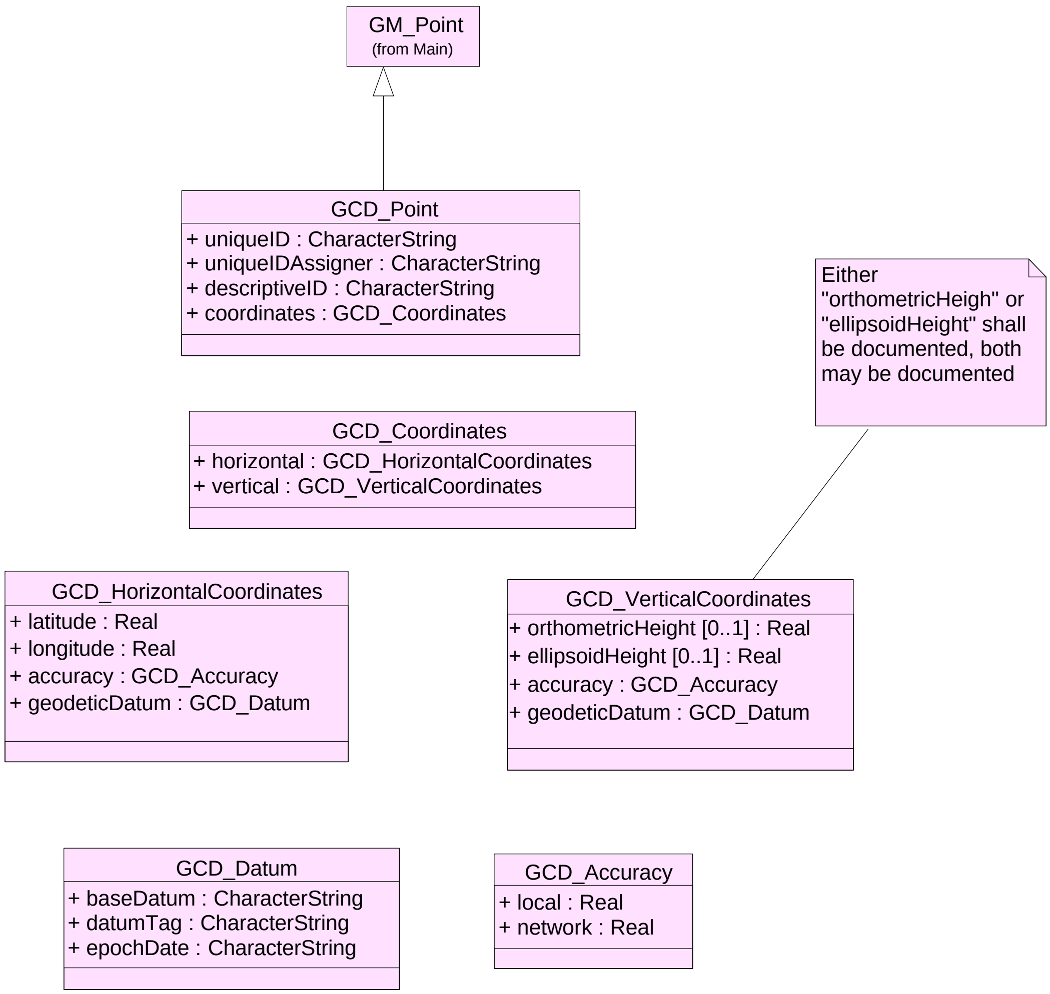
4.4.2 EPOCH DATE

The epoch date is used for stations in regions of episodic and/or continuous horizontal and vertical crustal motion where the coordinates change with time. The epoch date indicates the date the published horizontal coordinates and heights is valid. All points with adjusted horizontal coordinates and/or heights that fall within a designated crustal motion region will have an epoch date based on the date of the latest survey from which the coordinates were determined. Points outside designated crustal motion regions will not have an epoch date.

5.0 Maintenance Authority

The U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, National Geodetic Survey, maintains accuracy standards for geodetic networks for the Federal Geodetic Control Subcommittee, Federal Geographic Data Committee. Address questions concerning accuracy standards for geodetic networks to: Director, National Geodetic Survey, NOAA, N/NGS, 1315 East-West Highway, Silver Spring, Maryland 2091.

6.0 Geodetic Control Data Content Standard Unified Modeling Language (UML) Model



See Appendix 8.4 - Geodetic Control Data UML Data Dictionary

7.0 Geodetic Control Data Content Standard Data Dictionary

	Name/Role Name	Definition	Oblig./ Cond	Max occur	Data type	Domain
	GCD_Point	As defined in standard ISO 19107, Geographic Information Spatial Schema, (See item [4] in section 2.1)			specialized class (GM_point)	
	uniqueID	The **permanent identifier** can be the organization's unique data base identifier or one generated for this data set. (See section 4.1.1)	M	1	Character String	Text
	uniqueIDAssigner	The **namespace** is the organization's identifier (e.g., abbreviation) for the organization who assigned/maintains the permanent identifier. (See section 4.1.1)	M	1	Character String	Contents of: Appendix C - Contributors of Geodetic Control Data in *Input Format and Specifications of the National Geodetic Survey Data Base*, [17]. NOAA/NGS is managing authority.
	descriptiveID	The designation/station name or mark stamping which provides the user with a more understandable name for the point. (See section 4.1.2)	M	1	Character String	Text
	coordinates	Consists of two types, **Horizontal** and **Vertical**. BOTH types are mandatory. (See section 4.2)	M	2	Class	GCD_Coordinates

	GCD_Coordinates				Class	
	horizontal	One of a pair of coordinates referred to a coordinate system on an ellipsoid taken to represent the earth. (See section 4.2.1)	M	1	Class	GCD_HorizontalCoordinates
	vertical	The vertical distance measured along a vertical if a point above or below a reference datum. (See section 4.2.2)	M	1	class	GCD_VerticalCoordinates

	GCD_Horizontal Coordinates				Class	
	latitude	The angular coordinate of a point specified as the angle from an equatorial plane to a suitably chosen line through that point. Expressed in decimal degrees. (See section 4.2.1)	M	1	Real	-90.0 to +90.0
	longitude	The dihedral angle (usually taken counterclockwise) from a plane of reference to a plane associated with the point of interest, both planes perpendicular to a third plane (usually the equatorial plane). Expressed in decimal degrees. (See section 4.2.1)	M	1	Real	-180.0 to +180.0
	accuracy	Closeness of an estimated (e.g., measured or computed) value to a standard or accepted value of a particular quantity. (See section 4.3)	M	1	Class	GCD_Accuracy
	geodeticDatum	A set of constants specifying the coordinate system used for geodetic control, i.e., for calculating coordinates of points on the Earth. (See section 4.4)	M	1	Class	GCD_Datum

	GCD_VerticalCoordinates				Class	
	orthometricHeight (0.. 1)	The distance between the geoid and a point measured along the plumb line and takes positive upward from the geoid. Expressed in meters. (See section 4.2.2)	C	1	Real	-9999.9 to +9999.9
	ellipsoidHeight (0.. 1)	The distance of a point above the ellipsoid. Expressed in meters. (See section 4.2.2)	C	1	Real	-9999.9 to +9999.9
	accuracy	Closeness of an estimated (e.g., measured or computed) value to a standard or accepted value of a particular quantity. (See section 4.3)	M	1	Class	GCD_Accuracy
	geodeticDatum	A set of constants specifying the coordinate system used for geodetic control, i.e., for calculating coordinates of points on the Earth. (See section 4.4)	M	1	Class	GCD_Datum

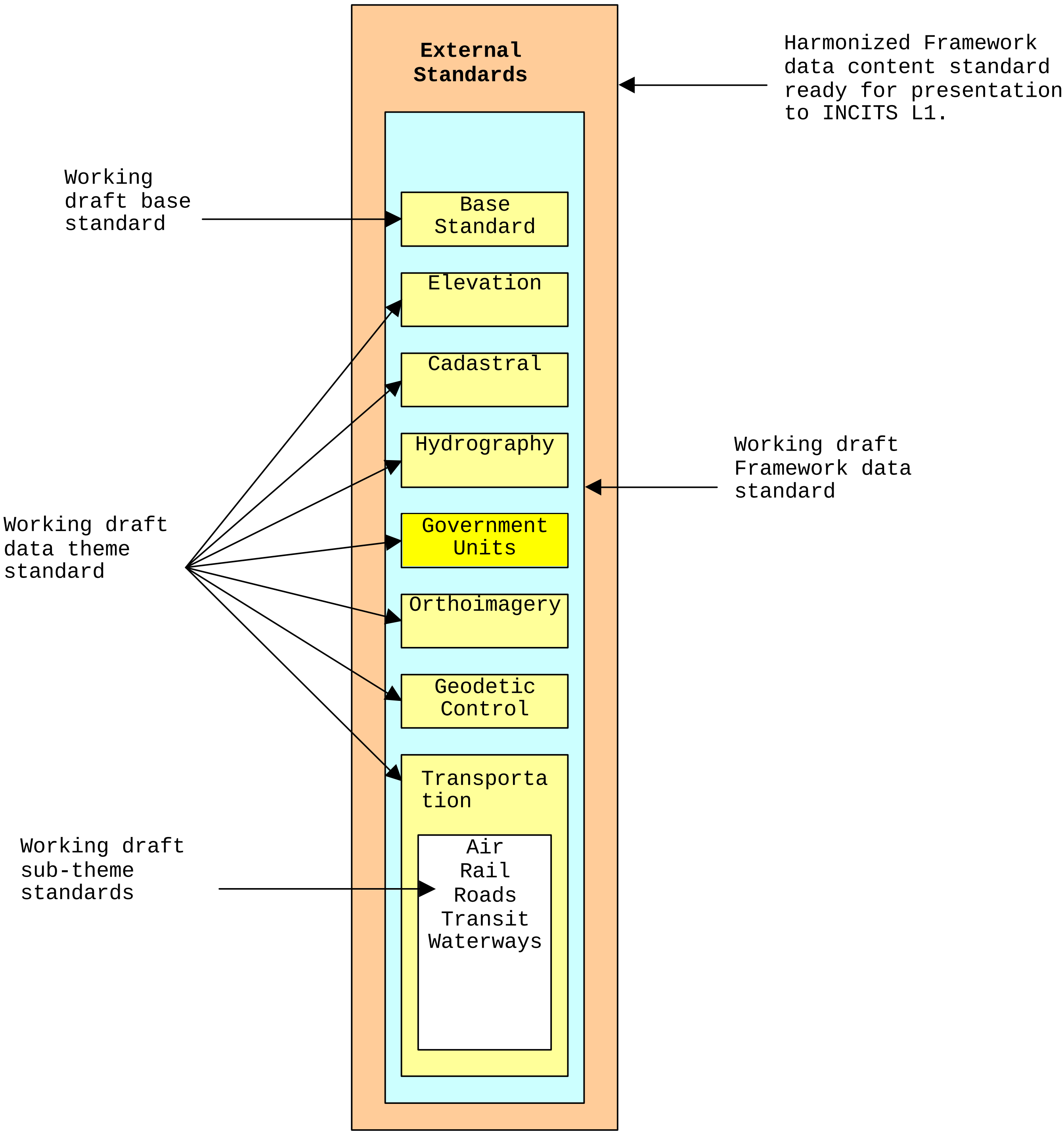
Note: It is mandatory that either the orthometricHeight or ellipsoidHeight is present. It is optional to have both present.

	GCD_Accuracy				Class	
	local	The uncertainty in the coordinates of the control point relative to the coordinates of other directly connected, adjacent control points at the 95 % confidence level. Expressed in meters. (See section 4.3)	M	1	Real	0.0 to 999.9
	network	The uncertainty in the coordinates of the control point with respect to the geodetic datum at the 95-percent confidence level. For NSRS network accuracy classification, the datum is considered to be best expressed by the geodetic values at the GPS Continuously Operating Reference Stations (CORS) supported by NGS. Expressed in meters. (See section 4.3)	M	1	Real	0.0 to 999.9

	GCD_Datum				Class	
	baseDatum	A set of constants specifying the coordinate system used for geodetic control, i.e., for calculating coordinates of points on the Earth. For Horizontal and Ellipsoid Height reference value is “NAD 83". (See section 4.4) For Orthometric Height reference value is “NAVD 88".	M	1	Character String	“NAD 83" or “NAVD 88"
	datumTag	Unique identifier assigned by NGS indicating the specific regional horizontal or 3-D adjustment with which the position of this control point is associated. Expressed as 4-digit character string. (See section 4.4)	C	1	Character String	Adjustment data are maintained by NOAA/NGS as managing authority. “1986", “1990-2003", or “NSRS”
	epochDate	Date after which these coordinates should be of the point lying in designated crustal motion region. Unique identifier assigned by NGS indicatingthe specific regional horizontal or 3-D adjustment with which the position of this control point is associated. Expressed as 5-digit date (CCYY.y) (See section 4.4)	C	1	Date	Epochs of regional crustal motion models maintained by NOAA/NGS as managing authority.

8.0 Figures

8.1 Nested Relationship of NSDI Framework Data Content Standard Harmonization



9.0 Appendices

9.1 Permanent Identifiers

Problem/Issue

The Geospatial One-Stop Data Content Standard should ensure that each theme modeling real-world[1] features assigns permanent identifiers to the digital representation of those features so that standard conformant data exchanges carry the identifiers and sufficient information about them.

Solution

1. For purposes of data exchange, each model shall contain an attribute at the feature level called "permanent identifier."
   - 1.1. The permanent identifier shall be mandatory for themes modeling real-world features[2].
   - 1.2. The permanent identifier is intended to be consistent between multiple exchanges of the same dataset.
   - 1.3. Multiple representations[3] of the same feature may not have the same permanent ID.
     - 1.3.1. Data providers must identify each representation uniquely and must describe its method for the recipient.
     - 1.3.2. Data providers may decide how to uniquely identify each representation[4].
   - 1.4. The permanent ID shall be a string.
   - 1.5. The identifier for a feature should not be changed over time, and an identifier should not be re-used to identify a different feature.
   - 1.6. Ideally permanent identifiers would be universally unique, but they must be unique within a namespace.
2. For purposes of data exchange, each model shall contain an attribute at the feature level called "namespace."
   - 2.1. Namespace refers to the person, organization or entity responsible for ensuring the uniqueness of the identifier attached to the feature.
   - 2.2. Namespace may be applied to features packaged in different types of exchanges – e.g. for an individual dataset, a business use, a Framework theme, etc. – as needed to ensure the uniqueness of the identifiers.
   - 2.3. Namespaces values must be unique.
3. Each theme shall provide guidance for populating these data and make public information about the method used.

   Ideally methods would be agreed to by the community of users.

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[1] Refers to both physical features and administrative features, such as boundaries.
[2] Because orthoimagery and elevation do not model such features, exchanges of these data would not contain feature-level permanent identifiers.
[3] For example, representing a road by a centerline or edge-to-edge; representing a city on a map as a dot or as an object with geometry; representing changes in a stream as it moves over time; etc.
[4] For example, concatenating the feature ID with each representation ID to create a unique, permanent identifier for each representation.

NOTE: The permanent identifier problem and solution statements above were developed in teleconferences as part of an early effort to harmonize issues that involved two or more themes. Permanent identifiers is one of several “cross-cutting” issues a harmonization team will take up this summer. That team will be composed of federal and non-federal MAT members. The resolution of each cross-cutting issue will become a part of the harmonized draft. All Geospatial One-Stop MAT members and reviewers, plus other interested parties, will be invited to comment on the harmonized draft.

9.2 Geodetic Control Data Content Standard - EXAMPLE

Unique Identifier:

Permanent Identifier (PID) = MN0298
Namespace = NGS

Descriptive Identifier:

Designation = PUMKIN

Horizontal Coordinates:

Latitude = 41.583365925
Longitude = -103.664305564
Local Accuracy = 0.046
Network Accuracy = 0.066
Geodetic Datum = NAD 83 (1995) epoch 1997.0

Vertical Coordinates:

Orthometric Height = 1365.195
Local Accuracy = 0.002
Network Accuracy = 0.100
Geodetic Datum = NAVD 88 epoch 2003.0

Ellipsoid Height = 1346.13
Local Accuracy = 0.064
Network Accuracy = 0.127
Geodetic Datum = NAD 83 (1995) epoch 1997.0

9.3 User guidance for estimating Local and Network accuracy values based on using the older (e.g., first-order) accuracy methodology

Local accuracy for horizontal and vertical control points is similar to the older accuracy methodology, since they are both methods to describe the relative accuracy between points. Hence, the older methodology can be converted into Local accuracy by taking the average length of line, using the older defined accuracy of the points, and converting that into a value in meters. Examples for horizontal and vertical surveys are:

Second-order, class II horizontal survey (i.e., 1:20,000) with average length line of 3,500 meters:

3,500 x 1/20,000 = 0.175 meters

Second-order, class II leveling survey (i.e., 1.3 millimeters per square-root of the distance in kilometers) with an average bench mark spacing of 1 mile (i.e., 1.6 kilometers):

0.0013 x SQRT [1.6] = 0.0016 meters

Network accuracy for horizontal control points can be estimated in two ways. First, if the NAD 83 coordinates are consistent with the original NAD 83 adjustment, e.g., the original NAD 83 (1986), then the Network accuracy has been determined to seldom exceed 1.0 meters. Second, if the NAD 83 coordinates are the result of a state wide or regional High Accuracy Reference Network (HARN) adjustment, then the Network accuracy has been determined to seldom exceed 0.05-0.1 meters. If better values have been determined for Network accuracy for the area covered by the specific data set, then those values should be used in place of these “general” values.

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